THE POLAR METHOD

OF

ELECTROTHERAPY IN GYNECOLOGY.

APPLICATION, DOSAGE, AND MEDICATION.

BY

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IN this paper I shall treat of those points which are of more general interest and of practical importance in gynecological practice.

I. *Essentials for the successful use of electricity.*

II. *Manner of application, electrode, and instruments to be used.*

III. *Measurement and dosage.*

IV. *The method of applying medicinal agents, or electro-medication.*

The use of electricity is rapidly gaining in favor among gynecologists, and this is due to the *galvanometer*, mainly, hardly less to the introduction of the *polar method—i. e.*, the direct application to the tissues, and to the use of *strong, effective currents*—making it possible to apply the current without those long sittings of twenty and thirty minutes, which

[1] Read before the St. Louis Medico-Chirurgical Society.

made it an impossibility for the busy practitioner heretofore. These are the essential features of the gynecological electrotherapy of to-day, in which the *electricity* which I advocate differs from the medical electricity which has so long remained in a very dubious light before the profession.

This questionable medium has at once become a valuable agent; a very perceptible change is taking place in the profession; the very men who, not a year ago, denied the possibility of measurement and dosage, now appear as converts: the admirers of mild currents and half-hour sittings continued for months, are hushed by the undeniable logic of facts, by the astonishing results achieved by effective currents in a few short sittings; in short, medical electricity is now emerging from the primitive condition in which it has too long remained.

Whilst commerce and industry have developed the most wonderful properties in this agent, and have utilized it to a marvellous degree, the medical profession has almost ignored it, though known for an entire century, since the time when Galvani, at sunset, on a September evening, one hundred years ago, while endeavoring to suspend the legs of a skinned frog, by a copper hook through the spinal column, to the iron railing of his garden terrace, observed the twitching of the muscles when the copper hook touched the iron railing. This event marks the first progressive step in the history of electricity since the discovery of the remarkable property of amber, 600 years B.C.

Fertile brains soon developed the discovery of the Bolognese savant, which found favor especially among the French.

The most important advance in the use of galvanism as a medicinal agent is, however, due to the

labors of Remak, of Berlin, forty years ago, which we must accept as the basis of our work; upon this we build.

Physiologists have developed the science, and neurologists have applied it, but the profession at large has gained but little; indeed, we may say that the teachings of Remak have not been utilized as they should have been. Gynecologists were not successful, because they merely followed the specialists, the neurologists, who had adapted the new remedy to their own particular purposes, in a very different sphere; isolated, and even wonderful successes were reported, and created a temporary interest, which soon subsided. Even the success of Cutter, of New York, in the destruction of fibroid tumors, seventeen years ago, remarkable as it was, did not arouse emulation. The excellent results of Bruns, of Tübingen, in the treatment of goitre, and of nasal polypi, were noted by only a few and forgotten by them; the brilliant application of the electrolytic properties of galvanism for the destruction of supernumerary hair in the eyelid, made by our friend Dr. Michel, of St. Louis, would have met with a similar fate had it not been made so valuable to dermatologists by our colleague Dr. Hardaway, so that among a limited number of specialists this one property of galvanism was thoroughly appreciated; but to the profession at large the electric current still remained the same mysterious agent, regarded with indifference, with distrust, or with awe, until Apostoli, in 1883, gave us the key to the successful application of electricity for the destruction of fibroid tumors by urging, 1. Localization, the limitation of effect to one active pole, which must be placed within the tissues; and, 2. The use of currents stronger than any hitherto applied in medical practice. Upon these fundamental

laws I have based the theory and practice of gynecological electrotherapy.

Little can be said of electricity in gynecology; it has had no influence whatsoever upon the development of this rapidly progressing specialty; reference to even the latest and most thorough text-books affords the best proof of this fact.

The gynecologist, unacquainted with the varying properties of the electric current, resorted to this remedy only when all other means had failed; in the most difficult and unyielding cases he tried an agent with which he was not familiar; he naturally failed, and as naturally ascribed his failure to the remedy he used.

Need we wonder that no attempt was made to apply electricity in gynecological practice, when Sir James Y. Simpson stated that "Electrization of the uterus was all but useless, and that when uterine action had been apparently excited by galvanism it was *a mere coincidence*, or resulted from an impression made on the mind of the patient, or on the abdominal parietes by the electrode." Very little more advanced in his practice is Powell, a writer on medical electricity twenty years ago, who ridicules Simpson for this statement in his *Practice of Medical Electricity*, published in Dublin in 1869; though he tells us that the utmost care should be taken in recording cases, etc., he himself gives the following case histories: "Galvanism and faradism were applied for three weeks, and with marked benefit;" or, "he was put under a course of galvanism, and in five weeks the power of the arm began to return."

This was a time when, in the famous Guy's Hospital, patients were treated by shocks from Leyden jars passed through the pelvic regions from the

sacrum to the pubis, giving the very acme of what we most cautiously avoid in its mildest form—*i. e.*, shock.

But we can go down to the very latest literature without an improvement in that vagueness which has killed electricity as a medicinal agent. What is the practice of those who in their writings urge precision in application and measurement? What is the practice of those who preach exactness, and tell us that the want of progress is due to want of precision? By their own case records we see that they themselves commit precisely the same error.

We are in a stage of transformation, light is beginning to dawn, the importance of precision in application, dose, and record, is beginning to be appreciated, but not as yet fully understood or practised; so we see one writer telling us that Apostoli applied *one and a half and two and a half ampères;* another says that whilst he formerly used only twenty-five milliampères, he now has applied as high as *ten ampères*[1] (*ten thousand milliampères!*); another is recording the strength of faradic currents in milliampères.

The state of gynecological electrotherapy is not yet clear; hence, I believe that a practical exposé is in place, and conditions are now favorable to pro-

[1] *Ten ampères* is the current used for the large electric lights on our streets; inside lights in hotels and stores need a current of only six ampères.

Ten ampères, through a resistance of sixty ohms, which is as low a resistance as we may expect in a fibroid, means a force of *six horse* power, this in electro-chemical force or heat would destroy the abdomen in a few moments. Any unlucky fireman who for a moment touches non-insulated parts of a wire carrying a ten ampère current is struck dead, and yet one enthusiastic electrotherapeutist claims to have applied a current of ten ampères to a living woman! Electric measurement is beginning to be appreciated, but is by no means understood.

gress since gynecologists are beginning to develop the science. Hitherto nothing has been achieved for the reason that the gynecologist has followed the neurologist, and has endeavored to follow the practice of the latter in his specialty; this led to injurious or to negative results, and the agent was condemned either as dangerous or as useless. As electricity for illuminating purposes differs from electricity as a motor, so does the electrotherapy of the neurologist differ from that of the gynecologist, and I look upon the clear understanding of this distinction as absolutely essential to the development of electrotherapy; the want of it has been one of the most effective bars in the way of progress. Success was impossible with the indiscriminate application of electricity in the various branches of medicine; in gynecology we deal with resistances of 200 and 300 ohms, as low as 40, but never above 600 or 800, whilst we use currents up to 250 milliampères, most commonly between 20 and 80 milliampères; the neurologist, on the contrary, rarely goes as high as 20 milliampères, and usually uses from 2 to 5 milliampères, and the resistance of the tissues between his electrodes is from 5000 to 10,000 ohms and over.

An essential to successful gynecological electrotherapy is a smooth current, the most complete avoidance of shock, which is, on the contrary, a valuable feature in the practice of the neurologist; we carefully avoid the effect of opening, closing, and reversing of the current, which is a highly important diagnostic and therapeutic resource in neurology.

Successful electrotherapy was impossible as long as electricity was looked upon as an agent applicable here and there in the same way, and it has been my

aim to establish and develop gynecological electrotherapy: as in all matters, if we wish to succeed we must ourselves work to our own especial purposes, I have, therefore, confined my work and my writing to the subject of *gynecological electrotherapy* and I wish it to be clearly understood that I make no reference to other applications.

The conditions are peculiarly favorable for the application of electricity to the female pelvic viscera:

1. The current can be confined to the part under treatment, as all the organs are gathered within the limits of the pelvis.

2. Diseased organs or morbid products can be reached directly by the electrode.

3. The low electrical sensibility of the parts makes the use of very strong currents possible. The skin, an electrically sensitive part, is not necessarily involved, and if so, only at the site of the indifferent or dispersing pole; as this is the abdomen, the current can be dispersed to any desired extent. The active electrode need never be in contact with the skin, and, however strong the current, the active intra-pelvic pole need cause no pain.

4. The polar method can, by reason of the situation of the parts, be successfully applied and fully utilized, and by this method only are speedy results possible in gynecological practice.

I. Essentials for the Successful Use of Electricity in Gynecological Practice.

As I have discussed the subject at length in my first paper, on "The Use of Electricity in Gynecology," read before the American Gynecological Association, in September, 1886, I will here only recall the important points; these are:

a. Localization of the current. The current must

be localized and its effect confined as far as possible to the diseased organ or part.

b. Use of one active pole. One pole exclusively, chosen for its peculiar properties, must serve as the active agent for the application of the current, and upon this its entire effect is concentrated; this is termed the active pole.

c. Dispersing of the current. The current at the other pole must be neutralized as much as possible, and its effect rendered as little as possible perceptible; to accomplish this it is dispersed upon as large a surface as the configuration of the part will permit; hence, a dispersing electrode is used in connection with the indifferent or neutral pole, called the dispersing plate.

d. The active pole should be directly in contact with the organ or part to be acted upon, or even within its tissue.

e. The indifferent or *dispersing pole should be opposite to the active pole so as to confine the tissue to be affected between their surfaces;* it must be as near as possible to the diseased part and upon the largest and least sensitive surface which can be utilized.

f. Use of effective currents. Currents of sufficient strength to accomplish the object desired in the shortest possible time, without detriment to the patient, should be used.

The intensity of the current used in gynecological practice varies from 1 to 300 milliampères; of most general use are currents of from 20 to 80 milliampères.

It must be remembered that I am not merely urging the use of currents as strong as possible, but of *currents strong enough to be effective.* Whilst a current of one or two milliampères will relieve the pain of a contusion, a current of ten milliampères

will aggravate it. The intensity must be commensurate with the object in view.

g. Precision in dose and measure. Knowledge of the force used and exactness in dosing it are a *sine qua non* to the effective application of electricity. It is as necessary to know the electro-motor force of the elements and the milliampère intensity of the current used as it is to know the strength of a chemical solution, and the number of grains of the drug which are to be given.

h. Use of proper instruments is as necessary to the electrotherapeutist as it is to the surgeon. The battery, by which the force is generated, is useless without proper means of dosing and of applying it, the milliampèremeter; suitable electrodes for the application of the current at the active pole, and for its dispersion at the indifferent pole, are fundamental requirements for a successful electrotherapy.

Upon the acquisition of these aids the recent progress of gynecological electrotherapy is based.

i. Recognition and proper use of the various qualities of the electric current. The electric current, both galvanic and faradic, is a most subtile agent, which may be made to serve many purposes, and which possesses numerous, greatly varying, and even antagonistic properties, which can be developed at will by the accessory apparatus and the method of application.

The following are the most important factors by which the properties of the electrical current are changed, and upon which its varying medicinal effect depends.

GALVANIC.	FARADIC.
varies with	
Intensity: number of elements.	Intensity; distance between primary and secondary coil; influenced less by electro-motor force of generating element.

GALVANIC.	FARADIC.
varies with	
Pole; negative, alkaline, fluidifying, stimulating; positive, acid, coagulating, sedative.	Pole; slight difference; negative, more irritating, painful; positive, less painful, more serviceable for deep application.
Time of use.	Time of use.
Constancy.	Number and length of interruptions; method of increase and decrease.
Size, shape, and material of electrode.	Size, shape, and material of electrode.
Metallic for chemical effect.	Metallic for irritation.
Moist, non-metallic, for distribution and penetration.	Moist, non-metallic, for penetration.
	Length and thickness of wire in secondary coil.
	High tension, effect on nerves by long secondary coil of fine wire.
	Quality and low tension, effect by short coil of heavy wire.
	Primary current more penetrating with metallic electrode.
	Secondary current more penetrating with moist, non-metallic electrode.

The therapeutic effects developed by the various properties of the current, so changed, are numerous, and electricity may be applied to serve as a

Sedative.
Stimulant.
Counter-irritant and vesicant.
Muscle contractor.
Antispasmodic.
Tonic.
Promoter of development.
Absorbent.
Chemical cautery.

Coagulator.
Electrolytic.
Hemostatic.
Promoter of hemorrhage.
Decongestor.
And as a medicator.

II. Manner of Application, Electrodes, and Instruments to be Used.

The greatest concern is generally felt in regard to the point of least possible importance—that is, the battery itself; the question, *What is the best battery?* is so often asked that I will again repeat that *this is immaterial as regards the effect.* The current is the same, whether we use the sulphate of copper telegraph cell, the zinc and carbon telephone cell, the Leclanché cell, or any of its modifications, or the ordinary medical dip battery. The physician must adapt his battery to his convenience and to his pocket. For stationary and cabinet batteries I deem the sealed Gonda Leclanché or the Diamond the most convenient; both with muriate of ammonia, zinc, and carbon; the former with the oxide of manganese disk in place of the porous cup, which is liable to clog. This battery works steadily, and requires the addition of distilled water every six months, cleansing and refilling every year. The fluid is simple, non-corroding, and odorless. Portable batteries are now made with similar hermetically sealed cups of smaller size, and these, of course, are far more convenient than the dip batteries, which have so long ruled; of these, the Stöhrer battery was the type. It seems, indeed, strange that in this progressive inventive country, from which all electric progress comes, these filthy, corrodable batteries

should so long have remained the universal favorite. The hermetically sealed open circuit battery, with dry cups, or, at least, with harmless, odorless fluid, is the battery of the future for cabinet and portable purposes.

The important instrument is the milliampèremeter, graded for general purposes from 1 to 100, for special work from 1 to 250 or 300. No work can be done without this, and it must always be in the circuit to be really useful.

The current selector I need not mention, as no battery is without one, and it is all-important that we have this means of gradual increase of the current, element by element, which I deem of more general utility, more simple, and almost as gentle as the water rheostat.

The wire rheostat to measure resistance, the interruptor, the metronome to break the current, the rheotome to change the current, the water rheostat to interpose resistance, or increase or decrease the current without even the slight jar occasioned by the insertion of single elements, are not necessary for ordinary work; but these, like the coulombmeter to measure the quantity of electricity, the voltmeter to measure the electromotive force of the elements, and the ampèremeter to measure their ampère capacity, are all demanded for progressive scientific investigation.

The *electrode*, the most simple of all the accessories, and on account of its very simplicity the most neglected, is as important as the battery itself. I blame that despicable sponge electrode in part for the neglect into which electrotherapeutics have fallen in this country; every battery was supplied with two of these abominations, and as the practitioner soon found that he could not accomplish

much with them, he thought electricity useless and put aside his battery.

The sponge electrode is a filthy, current-absorbing instrument, which must be cast aside. If a small electrode is wanted, the metal plate can be used, covered with absorbent cotton soaked in warm water; this offers no appreciable resistance and is renewed without any trouble for each patient; in fact, time and trouble are saved, as it takes more time to soak thoroughly the sponge electrode than it does to cover the disk with absorbent cotton and apply this instrument, which is saturated by momentary immersion.

I propose to speak more fully of the *dispersing electrode*, as it is this which is so important, partially so from the fact that on account of its very simplicity it has been neglected. Electrodes for various purposes, for use in connection with what I call the active pole, have been devised in numerous forms to suit the locality in which they were to be used, throat, ear, uterus, or bladder, but where any but the mildest currents are to be applied these are ineffective unless the current at the indifferent pole is sufficiently dispersed; only by rendering the neutral pole painless, by dispersing the current at this pole sufficiently to render it indifferent, can the other active pole be effectively used.

For this purpose then we must have an electrode of large surface and of good conducting material, so that the resistance it offers is reduced to a minimum. The stronger the current, the more intense the effect derived from the active pole, the larger must be the surface for its dispersion at the indifferent pole, and the larger must be this surface that the peculiar effects of this pole may be neutralized and that cauterization may be avoided.

The effect of the active pole is in no way reduced thereby, as the density of the current is not appreciably diminished in applications by the polar method, whether the dispersing electrode is large or small.

The larger this is, the better; its size is limited by the surface to which it is applied, and for gynecological purposes three sizes are desirable.

No. 1. 6¼ by 9¼ inches = 58⅓ sq. inches surface.
No. 2. 4½ by 6¼ " = 28½ " "
No. 3. 3½ by 4½ " = 15⅔ " "

No. 3 is used with mild currents, and preferable when possible, as it is easily placed without disturbing the clothing, even under the corset; this should, as a rule, not be used with currents of over 15 or 20 milliampères.

Attached to a long, insulated handle, it makes a good spinal electrode, better for this purpose is one 3 inches by 5 inches, with the same surface (15 square inches).

No. 2 is still readily manipulated, though not so easily shifted from side to side and must be used with currents from 20 to 60 milliampères.

No. 1 is necessary for intensities above 60 milliampères, if the current is to be applied without giving pain; to place this the clothing must be loosened.

These three sizes will generally suffice, although I have used No. 0, 8 inches by 10 inches with a surface of 80 square inches, for the application of very high intensities in electrolysis, and No. 5 for cutaneous faradization, round, 2 inches in diameter, like the old sponge electrode.

I would urge these dimensions for general adoption, in order that that uniformity which is so desirable to an understanding may be attained.

The electrode consists of a pliable sheet of lead perforated with holes one line in diameter, one inch apart, and is covered with a layer of punk or absorbent cotton, which is held in place by a thin buckskin or kid. These electrodes conduct as well, and are in every way as serviceable as the clay electrodes of Apostoli. The cover is immaterial, if a good conductor and absorbent, but it is important that the *plate* be of *very pliable* metal, so as to adapt itself to the undulations of the surface upon which it may be placed.

The electrode must be soaked in hot water, the superabundance of which is expressed before it is placed. The water is to be as hot as it is comfortably borne by the patient; cold water must be avoided, as it lessens the conducting power of the electrode, offers greater resistance than hot water because it does not saturate the epidermis so rapidly, and because it is not only uncomfortable, but might even endanger a patient suffering from a chronic inflammatory trouble, for which we so often make these applications. Salt must be avoided; it is not necessary, as it was for the poorly conducting sponge electrode, the instrument which I suggest being a much better conductor, and salt is injurious to instrument and patient. When used upon electrodes by which currents of high intensity are applied, the electrolytic action of the galvanic current decomposes the salt, and chlorine is developed at the positive pole, by which the amount of pain may be increased and the electrode is corroded. Upon a mucous surface the effect of the chlorine generated at the positive pole from a salt water electrode is very perceptible.

The shape of the electrodes used with the *active pole* varies greatly with the object for which it is ap-

plied, and any number have been devised; important for the gynecologist and serviceable in the majority of cases are the following four:

1. A fine, pliable uterine probe, insulated up to within three inches of its end by a glass tube which can be removed (glass or hard rubber being preferable as they can be washed in acids and rendered thoroughly aseptic).

2. A heavy, but pliable uterine sound, equally insulated.

3. A needle or stylet for puncture, to be used within the tissues, with movable insulator.

4. A metal ball or oval-shaped electrode with six-inch insulated stem, for vaginal applications.

These electrodes must be so arranged that firm connection, best by a screw, can be made with the rheophore; and one of the intrauterine electrodes must be of non-corrodable metal, best of platinum, for use in connection with the positive pole; as oxygen and acids are set free at this pole, an electrode of corrodable metal is soon affected and is not only rendered useless, but is imbedded in the tissues and hard to withdraw.

It will be found convenient to have a stylet and sound in one and the same instrument, of platinum, one end straight and pointed, the other curved and blunt, which can be inserted with either end in the handle, to be used as a sound or stylet.

III. Dose and Measure.

For proper *dosage* the following elements are required in

Galvanism.	Faradism.
Milliampère intensity of current.	Strength of current by distance between primary and secondary coil.
Time of application, by which quantity of electricity used is determined.	Time of application.

GALVANISM.	FARADISM.
	Number of interruptions.
Square surface of dispersing electrode, for record of density.	Size, shape, and material of electrode.
	Tension and quality of the current as determined by the length and thickness of the wire in the secondary coil.

Other measures by which all details of the application are recorded with precision for scientific research, though not necessary for simple treatment, are the following:

GALVANISM.	FARADISM.
Resistance of the tissues and electrodes in ohms.	Resistance of the tissues and electrodes in ohms.
Density of the current.	
Quantity of electricity used expressed in coulombs.	
Electro-motive force of the elements used in volts. Ampère capacity of the elements used in ampères.	Electro motive force of the elements used in developing the current and their ampère capacity in ampères.

The galvanic current, thanks to its commercial value, can now be measured and dosed with the utmost precision, and all its practically important characteristics can be more accurately recorded than those of any other medicinal agent. For all practical purposes—I am speaking only of the application of galvanism by the polar method, in gynecological practice—we need only know the *intensity* of the current in milliampères, the *time* of application, and the *site, nature, and size of the electrodes.*

The *resistance* of the tissues in ohms is not practically necessary, as in gynecological practice we know that the resistance varies between 60 and 800, usually between 200 and 300 ohms, and this is more closely indicated by the location of the poles, as the

physician who applies electricity judiciously and scientifically should know about what the resistance of certain parts generally is.

The *density* of the current, however important in other methods or in other localities, varies but little in gynecological treatment by the polar method, as it is practically the same in all but the intrapolar applications, as, for instance, to the ovaries. The active pole being always small, either stylet or ball, the effect sought in its immediate vicinity differs but little whether the current is dispersed upon a large or small plate. Still I have named the location and size of the dispersing electrode among the elements necessary for dosage and record; by means of this the density can be calculated, though I have included it, not for this purpose as much as for the convenience of the physician to facilitate repetition.

The practically important elements for record and dosage of faradic currents are the electro-motive force of the generating element, with the distance between the coils, the character of the secondary coil, and the number of interruptions per minute; but this will only be possible with perfect standard instruments, which are not yet made in this country, so that this is as yet impossible, and the utility of this form of electricity is very limited, on account of the imperfect apparatus in the hands of the profession.

The determination of the milliampère intensity of a faradic battery is more than useless, it is deceptive, as the ampère intensity carries no conception of the true force of this kind of electricity, which is produced by induction, and by frequent making and breaking of the current.

If passed through a coil of long wire the milliampère intensity is greatly reduced, and yet the effect

of the current is increased. I mention this only to prevent entanglement by the erroneous ideas advanced by some.

Measure and Dosage of Galvanism.

The milliampèremeter. Upon the use of this instrument, absolutely essential to successful practice, the present advance in gynecological electrotherapy is based. The instrument may be either horizontal (tangent) or perpendicular, and for gynecological purposes should indicate from 1 to 250 milliampères. Whilst the neurologist may need one with more exact reading from 1 to 10, enabling him even to distinguish one-half or one-quarter of a milliampère, the gynecologist must have wider scope, and, as a rule, exactness to a single milliampère is not essential; the intensity usually employed is from 10 or 20 to 60 or 80 milliampères; in rectal, urethral, and vesical applications, the want of an instrument plainly showing fractions of a milliampère is sometimes felt, as two or three milliampères only are used, but in general use this is unnecessary.

The high intensities are needed for purposes of electrolysis or cauterization.

Time of application is noted in minutes, and from this the quantity of electricity applied in the entire séance can be determined in coulombs, the unit of quantity.

For ordinary purposes the record of time only is needed. The importance of this element in determining the effect is self-evident.

Density. Square surface of dispersing electrode. This should be recorded to facilitate repetition, and, if desired, to determine the *density* of the current, which is of extreme importance in certain methods of application.

To simplify record, and further an understanding, it is very desirable that practitioners should adopt standard sizes of this important instrument; uniformity in size and even in conducting powers of dispersing electrodes is essential, as it is difficult to calculate with ever-varying factors, but if a standard be adopted this difficulty is obviated.

The three sizes I use I would suggest as most convenient for gynecological purposes:

No. 1. 59 square inches surface (6¼ by 9¼ inches) for higher intensities.

No. 2. 28½ square inches surface (4½ by 6¼ inches) for intensities from 20 to 60 milliampères, still applicable to the abdomen without difficulty.

No. 3. 15⅔ square inches (3½ by 4½ inches), easily manipulated and readily slipped under the clothing upon any part of the abdomen, can be used for all milder applications, and even with 40 milliampères if the patient be not too sensitive and the resistance low.

Resistance of the tissues and electrode in ohms. The ohm is the unit of resistance, and is measured by the rheostat. Upon the resistance of the tissue depends the intensity of the current possible and necessary.

The *greater the resistance* the *less the possible working intensity* of the current, but the *greater the electromotive force* and *ampère capacity of the generating battery* required. Hence the possibility of successful application of galvanism in gynecological practice; the resistance offered by the tissues is small, usually 200 or 300 ohms; and under these circumstances the patient can stand 100 or 200 milliampères; in percutaneous applications, as required in neurological practice, the resistance of the tissues is rarely as low as 1000 ohms, often 5000 and 10,000 ohms, and 5

milliampères is then a great intensity requiring strong battery force. In neoplasms and effusions, in which the highest intensities are required, the resistance is sometimes reduced to as low as 40 ohms, and at most it is never above 600 or 800 ohms. The resistance of the moist tissues is very low, and the nearer the electrodes can be approached to each other the less it is, as the amount of tissue is diminished.

The greatest resistance is offered by the dry epidermis, and in gynecological applications this is only to be encountered once, and not in all treatment; then the epidermis on the abdomen is not so thick and hard, and the surface is so located that it can be well saturated. When both poles are intrapelvic the resistance is naturally lessened, and very little ampère capacity of battery is required. The resistance in these applications is also lessened by the approximation of electrodes, the one in the vagina, in the uterine cavity, or in the tissue, comes very near to the other, over it upon the abdomen. Most effective, however, is the succulence of the tissues in reducing resistance, and these tissues, with the exception of the abdominal walls, possess low electrical sensibility. For these reasons the use of effective currents, inapplicable in other parts, is possible in the pelvic viscera. This is best explained by an example: In an electro-cauterization of the endometrium, with one pole, the sound, in the uterine cavity, and the other, the small plate, upon the abdomen, I can use 30 milliampères with but little pain, and may need 6 elements to develop these 30 milliampères through a resistance of 250 ohms. If I place the same small abdominal electrode on the back of the hand, and in place of the uterine sound, at the other pole, a round electrode in the palm of the hand, I will find a resistance of 3500 ohms from palm to back of

hand, and I will need 24 of the same elements to obtain 4 milliampères, and these 4 milliampères will cause as much burning as the 30 milliampères through less resistance, and in a more sensitive spot.

For an exact determination of the resistance of the tissues, the resistance of the electrode must be noted. That a knowledge of the resistance of the tissues under treatment is necessary, is evident from the influence of this factor upon the result. For general purposes of gynecological treatment, however, it can be dispensed with, as this resistance varies within known and narrow limits; but for other applications it must be noted, as the variation is very great, and so much depends upon it.

I myself have recorded the resistance in the cases treated, for the sake of study and observation, and believe that this should be done for the purpose of scientific observation, that rules of practice may be developed.

It is to the low resistance and slight degree of electro-sensation that gynecology owes the possibility of successful electrotherapy; 250 milliampères can be applied for electrolysis in a uterine fibroid, because the resistance may not be over 60 milliampères, and this can be accomplished without excessive pain, or the use of great battery force; whilst 250 milliampères sent through the body from hand to hand would cause instantaneous death; and no battery—nothing but a dynamo—sends such a current through a resistance of 15,000 ohms (at which I roughly estimate the tissues from hand to hand).

Density of the current. The greater the density of the current the more intense the effect, and, as we have seen, in gynecological electrotherapy and the polar method, the greatest density is attained, as the

effect is derived from the surface of one small pole, and the density of the current in the tissue surrounding this active pole varies but little, whether the dispersing electrode be large or small; hence, as has been stated, for mere working purposes, the record of this factor is of no value in gynecological electrotherapy, however important it is in other applications. The density has been expressed by the milliampère intensity divided by the square electrode surface, $\frac{\text{1 milliampère}}{\text{square surface of electrode}}$. It is an element which can be dispensed with practically in dose and record of gynecological electrotherapy; though of interest for investigations of scientific precision, and application to other parts. It is only in ovarian and similar intrapelvic intrapolar applications that we must take into account this element of density.

Quantity of electricity used. The coulombmeter. The coulomb is the unit of quantity, and is represented by the quantity of gas developed by a current of one ampère in one second of time, or by the amount of water displaced by the gas evolved by a current of one ampère in one second of time; in other words, a coulomb is the quantity that passes in one second of time against one ohm of resistance under the electro-motor force of one volt. One coulomb will decompose 92 microgrammes of water, and upon this decomposition the instrument for measurement is based: though not scientifically exact, like the milliampèremeter, it is sufficiently so for practical purposes.

In gynecological practice it is sufficient to calculate the amount of electricity used, which is easily done if the intensity of the current and time of application are known: As one ampère for one

second of time equals one coulomb, $\frac{1}{1000}$ of an ampère, or one milliampère, will equal $\frac{1}{1000}$ of one coulomb, in one minute, 60 seconds, will equal $\frac{60}{1000}$ or $\frac{6}{100}$ of a coulomb, and in five minutes, $\frac{30}{100}$ of a coulomb. The current used in an ordinary application, for instance, 20 milliampères for 5 minutes, equals $20 \times \frac{30}{100}$ or 6 coulombs; the same as if a current of 100 milliampères was applied for 1 minute, or of 1 ampère for 6 seconds.

I have made the measurements and calculations in my case records for the sake of observation and comparison, but I do not deem it necessary if milliampère intensity and time of application are given; it is merely one of the methods of measuring the galvanic current in all directions for precise determination. If a milliampèremeter is not at hand, the quantity may be measured by the coulombmeter, and, the time being known, and the resistance, the milliampère intensity may be calculated.

Electromotive force; the voltmeter. This is one of the measures used for determining the initial force of the agent, the power of the battery, or of the cells used in the treatment. One volt, the unit of electro-motive force, is a force sufficient to produce a current of one ampère through one ohm of resistance—that is, about equal to that of one chloride of silver, or of one Daniell, element.

The voltmeter used for measuring the electromotive force is an instrument similar in appearance to the horizontal galvanometer, indicating the force in degrees of deflection of a needle, which is impelled by the current passing through a coil of high resistance underneath the pointer. This instrument is of service in determining the value of a battery for galvano-caustic purposes, and for recording the force of the elements used, but is superfluous in

galvano-therapeutics for all but exact scientific work; it is not necessary for determining or recording the electric dose, but serves rather to define the status of the battery and of the elements used in the treatment; it tells us whether they are in perfect working order, whether they are deteriorating, and how they have been influenced by work or exposure.

The ampèremeter is used to determine the ampère capacity of the battery, or of the elements used in a given treatment; by this instrument, which is similar to the tangent galvanometer, the intensity of the current used for galvano-caustic purposes is determined, and it is our best means of recording this. In galvano-therapeutics it is useful for control of the battery and its elements, and by it the ampère capacity of the elements used for a given application, or the initial intensity of the current may be determined. It is, of course, not kept constantly in the circuit, like the milliampèremeter, but is inserted in place of the body and milliampèremeter, after the application has been made, to show the intensity of current as coming direct from the battery. It is of no importance to the practitioner, but cannot be dispensed with for a complete determination of all elements; by the ampèremeter, knowing the milliampère intensity of the current in an application, we can calculate the resistance of tissues and electrodes, and, as by the voltmeter, we can record the condition of the elements before and after a *séance*.

This instrument takes the place of the milliampèremeter in all cases in which no such high resistance, as in medical treatment, is interposed. In gynecological electro-therapy this measure is unnecessary for practical work, as the efficiency of the

treatment cannot be determined by the battery-force used, on account of the great resistance interposed, it serves us only for an understanding of the working power of the battery, and of the currents used in treatment, but for electro-cauterization and for mechanical purposes this is the gauge by which the work is measured. The ampèremeter is for the machinist, the electroplater and electro-lighter what the milliampèremeter is to the medical practitioner, who employs but an infinitesimal part of the electric intensity needed by the former.

Faradic Dosage.

The only precise measure applicable to faradic electricity is the electro-motive force and ampère capacity of the generating element, but these affect the therapeutic result too little to be considered in dosage. They are recorded only for scientific purposes.

For purposes of dosage we must as yet content ourselves with a rehearsal of the conditions by which the effects of the faradic current are determined.

Strength of the current is indicated by the distance between primary and secondary coil, as shown by the scale, but until a uniformity of instruments is achieved, this is of value only to the operator himself.

Time of application, of course, determines the effect and should be recorded.

Number of interruptions, which in my instruments, for instance, vary from 50 to 3000 per minute, is an important feature of the application and must be noted as one of the determining factors.

Size, shape, and material of the electrode affect the result greatly, and should be noted.

Tension and quality of the faradic current are perhaps its most important therapeutic factors, as the effect varies greatly with the nature of the secondary coil by which these are produced, hence this must always be noted.

A coil of long and fine wire gives high tension and little quality, whilst a short coil of heavy wire gives greater quality and less tension. By a current of tension the pain of cellulitis will be relieved, but the pain and swelling from a contusion will be aggravated; by a current of quality and low tension the pain of a cellulitis would be aggravated, the pain, œdema, and venous distention of a contused surface will be alleviated; the former is used mainly for nerve, the latter for muscular effects.

Resistance of the tissues is of no practical importance, as we have no measure of faradic intensity corresponding to the ohm as the ampère does. It is noted only for experimental purposes and future possibilities.

Nomenclature. I will here again call attention to the nomenclature which I have employed and which I have urged for general adoption, in my first paper, so that the recording of cases may be simplified and a general understanding facilitated.

The method of application is described by the location of the poles, the site of the active pole being named first, that of the indifferent or dispersing pole following.

Thus, in speaking of a *utero-abdominal faradization*, I refer to the application of the faradic current with the active pole in the cavity, and the indifferent pole on the abdomen; by *intrauterine galvanism* I have indicated the bipolar treatment—that is, both poles in the uterine cavity. If the word negative or positive precedes, this always refers to the character

of the first named, the active pole, viz., *positive recto-abdominal galvanism* tells us that the active positive pole is in the rectum.

The application of the bare metal pole to a surface with higher intensities of current is termed a cauterization. Thus, a *positive electro-cauterization* of the uterine cavity expresses in a concise form the application of the bare metal electrode, connected with the positive pole, to the uterine cavity, an intensity above 20 milliampères being used, whilst the current is dispersed at the negative pole upon the nearest available surface, the abdomen. When the cauterizing metallic pole is replaced by a non-metallic pole, such as a cotton-wrapped applicator, I term this treatment *positive utero-abdominal galvanism*.

Puncture is the introduction of the needle or stylet, the metallic pole, directly into the tissues with dispersion of the current upon the nearest available surface; a *negative electro-puncture* of a fibroid is the electrolysis by a stylet in connection with the negative pole inserted into the tissues of the fibroid, the current being dispersed upon the abdomen in the positive electrode. If this puncture is made *per vaginam*, we speak of a *negative vaginal electro-puncture*.

Record of dose. I have stated that intensity of current in milliampères, time of application, and square surface of dispersing electrode are necessary for determination of dose; to make this still more exact, I have always added a description of the active pole. An electro cauterization of the uterine cavity I have thus precisely recorded:

—E. C. 20 milliampères, 5 min. Fine probe. II. Plate.

i. e., 20 milliampères were applied for 5 minutes with the fine—Sims's—probe as negative pole in the

cavity, and II. plate with a surface of 28⅓ square inches, as the positive dispersing pole, on the abdomen.

This is the therapeutic application and dose fully defined.

In cases recorded for research with scientific precision other data are added; these I have arranged in the following manner:

—E. C. 8 Gonda Leclanchè elements 10⅔ volts, 0.63 ampère. Sims's probe, II. Plate; 20 milliampères, 5 min., 6 coulombs. 600 ohms resistance (tissues 586 ohms, II. Plate, 14 ohms).

This, in addition to the data essentially necessary for dosage, tells us that for this treatment 8 Gonda Leclanchè elements were used, with an electro-motive force of 10⅔ volts, and an ampère capacity of 0.63 ampère; that the quantity of electricity used in the treatment with effect upon the patient was 6 coulombs; that the entire resistance offered these 0.63 ampère of current, which allowed the use of 20 milliampères effectively on the patient, was 600 ohms, which is essentially referable to the tissues, but an examination of the dispersing plate shows that this offered a resistance of 14 ohms, which leaves 586 ohms for the tissues, the resistance of the apparatus and rheophores being trifling.

The dose of a faradic application I have recorded in the following manner:

+ V. A. Faradism, 4 min. 6 cm., 1500 I. Fine coil.

Or, in other words, the positive cotton-covered ball electrode in the vagina, the small dispersing plate on the abdomen, used for four minutes, the secondary coil 6 cm. from the primary coil, 1500 interruptions per minute, a current of great tension and little quality, the long coil of fine wire as secondary helix.

When I first advocated attention to measure and dose, being myself deeply impressed with the importance of the principles advocated by Apostoli, many of the ablest practitioners, who had long felt the want of precision as the check to progress, readily accepted the idea, but were unable to procure the necessary instruments—I am speaking of gynecologists; others, especially those who have assumed prominence heretofore in electro-therapeutic science, denied the practicability of such measure, and in the face of my claim for a progressive move and effective doses, urged mild applications. A change is rapidly being effected, the demand for instruments of prcision has created a supply, and whilst but a year ago hardly a milliampèremeter was to be had on this side of the Atlantic, and the galvanoscope was sold as a galvanometer, the market is now being supplied,[1] and the working members of

[1] Milliampèremeters of American make are now offered the profession, but I regret to say that, though I have tested several, I have not as yet found one which is perfectly accurate; some indicate *twice* the proper intensity, ten milliampères when they should indicate five milliampères, some two-thirds of the real strength of the current, etc. Every physician should test his galvanometer or have it tested by an expert electrician.

The most delicate test of the correctness of the instrument is the test of the intensity of the current by the amount of silver (or copper) deposited by it in a given time.

The simplest test, and sufficiently correct for instruments such as are used in medical practice, is by Ohm's law, $I = \frac{E}{R}$. Every physician can thus test his own galvanometer, if he has a rheostat and a cell of known electro-motor force and known internal resistance, and if the resistance of his galvanometer be known.

The test is made as follows:

$$I = \frac{E}{R} \text{ or Intensity} = \frac{\text{Electro-motor force}}{\text{Resistance}}.$$

Resistance consists of resistance, or R, of galvanometer plus in-

the profession are beginning to test the value of galvanism applied with precision and judgment, and those who not many months ago still upheld the theory of mild currents tested on the tongue, and long applied, are beginning to vaunt the effective strong current measured in milliampères. Erb and others have long since urged the importance of dose and measure, but a standard had not been adopted; the weber would not yield to the ampère or the Siemen's unit to the ohm, the instruments were rare

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ternal resistance of cell plus a certain rheostat resistance, which must be in a milliampère test, 1000 times E less (galvanometer R + internal cell R). Thus, if I take my Gonda-Leclanché cell

E = 1.3 volts.
R = 2 ohms.
R of my galvanometer = 0 4 ohm.

$$\text{I or one milliampère} = \frac{\text{1.3 volts.}}{\text{1300 ohms.}}$$

$$\text{0.001 m. a.} = \frac{\text{1.3 volts}}{\text{1300 ohms}}. \quad \text{1300 ohms} = R = R' \text{ of cell} + R'' \text{ of galvanometer} + R''' \text{ of rheostat.}$$

$$0.001 = \frac{1.3}{2 + 0.4 + 1297\ 6}.$$

In other words, my Gonda cell must show exactly one milliampère on a galvanometer, the R of which is 0.4 ohm, if I insert a rheostat R of 1297.6 ohms. This brings me to the great fault of the American milliampèremeters, also of the Stöhrer instrument, which lies in their unnecessarily great resistance, varying from 90 to 130 ohms; whilst the French, Gaiffe, instruments offer only 0.3 to 0.9 ohm resistance.

To the neurologist, who deals with resistances in the human body of 3000 to 30,000 ohms, this galvanometer R of 90 or 130 ohms is of no import; but to the gynecologist it makes a great difference; in his treatment of the pelvic tissues, which offer a resistance of from 60 to 300, a galvanometer R of 130 is an important factor.

Why waste as much battery force in overcoming the galvanometer R as is needed to overcome the R of the tissues? It is a needless loss of power, and herein lies the great advantage of the Gaiffe galvanometer, which offers an R which can be practically overlooked,—less than one ohm.

and costly, and, above all, those who urged precision and measure did not themselves set the example. In but few instances do we find case histories so recorded that the dose is stated with precision. Apostoli gave us the milliampère intensity, this was a most important step forward, also time of application, and the size of the electrode could be inferred. All the essentials were indicated, though not given for the purpose of thus noting dose; these I have systematized, and I believe that I can say that a correct and serviceable dosage has thus been attained.

If the good results of faradism, applied with scientific precision, were equally appreciated, the profession would also be supplied with effective faradic apparatus; but as yet this is only to be seen in the laboratory, and has not been accessible to the practitioner, hence it cannot be tested, and faradic electricity will slumber on as galvanism has done, until some enterprising mechanic gives a suitable instrument to the profession. With the apparatus now in the market, satisfactory results cannot be accomplished; a regulating interruptor, a sliding scale, and a series of graduated coils are wanted.

IV. Electro-medication.

We cannot doubt the value of electricity to man; that it is an agent of infinite power, and one adapted to all possible purposes, the discoveries of the last decade have shown, and this subtile fluid, which has added to so great an extent to the comfort and convenience of the human race, which is so well serving the outer wants of man, must now be made to contribute to the welfare of his inner being. The medicinal virtues of electricity are still to be developed; many attributes which are of value to us you

know—the contracting power of faradism, the chemical properties of galvanism, as you see by the affinity of acids for the positive pole, and of alkali for the negative, and the electrolytic action of galvanism, as shown by the rapid disintegration of water, hydrogen seeking the negative pole, oxygen the positive.

I have told you that I have instantaneously checked hemorrhage in the uterus post partum, by the contractile action of faradism in desperate cases, and by two applications brought about the menses which had ceased for a twelvemonth; that I have destroyed intrauterine tumors as large as a hen's egg in three sittings of five minutes each; completely relieved the distressing symptoms of congestion, gastritis, dysuria, and constipation, in a patient suffering from a large abdominal tumor, and reduced the circumference by five inches, by five consecutive daily treatments of eight or ten minutes each. I have dispersed the painful swelling due to a contusion of a joint, which had for three weeks resisted treatment, by a single mild application of faradism, and relieved the pain of articular rheumatism which opiates could no longer control. I have relieved aneurisms and destroyed angioma by the coagulating action of the positive pole, and increased the flow of blood from indurated hyperplastic uteri by the fluidifying action of the negative pole; a prolapse with œdema of the leg was relieved by faradism, and the patient, who had not walked for twenty years, was enabled to move about as freely as any one of her age, after a two months' treatment; a stenosis of the uterine canal, which caused agonizing menstrual suffering, was relieved in three sittings of five minutes each, and permanently overcome by six or seven more; the most obstinate pruritus, which had long resisted treatment, was cured by one application;

constipation and dysuria have been rapidly relieved after resisting the usual remedies. We have just discharged a poor girl who came to the clinic two months ago, partially disabled by a solid pelvic effusion, which had the appearance of a fibroid rather than of an inflammatory product, filling the pelvic cavity, displacing the uterus, and wedging the cervix in between the effusion and the symphysis; in twelve treatments, electro-cauterization, of five minutes each, with from 60 to 100 milliampères, the *complete absorption* of this mass was brought about, it has disappeared, leaving only the somewhat thickened normal tissues. How rapidly it was destroyed I cannot say, since no examination was made until the twelfth treatment, and then it was gone. Is not this a triumph?

An effusion, as hard as fibroid tissue can be, which had for five years been undermining the health of this poor girl, and at last almost disabled her by hemorrhage and pain, is dispersed by twelve painless treatments, which not only do not interfere with her work, but aid her in it by the immediate relief afforded; each application was marked by improvement and increased well-being: first hemorrhage, then pain subsided, whilst her strength steadily increased.

This rapid result has induced me to observe other patients more carefully, and I find similar effects in similar conditions, with an opportunity of observing the final disappearance, the steady decrease, of such effusions called fibroids by some.

Such are the results which may be obtained by the proper use of the "polar method," by the application of strong and effective currents, and their localization, as taught by Apostoli in the treatment of fibroid tumors. More still can be accomplished.

In an early paper I treated of electricity as a nerve sedative, and a stimulant, a muscle contractor, and antispasmodic, an antiphlogistic and counter-irritant, a vesicant, a tonic and promoter of development, an absorbent, chemical cautery and escharotic, electrolytic, hemostatic and decongester, and a promoter of hemorrhage and congestion. It has other properties still. Since then I have utilized it as a *medicator*, and although I have not as yet obtained such striking results, this property of the electric current is one so peculiar that it deserves recognition; I have termed *electro-medication* this method of treatment by the *nascent ions* of an *electrolyte*.

By the electrolytic, or electro-chemical, action of galvanism water is resolved into its components H and O. Bromide of potash, iodide of potash, muriate of ammonium, and chloride of sodium respond in a precisely similar manner, while the bases are set free at the negative pole, the metalloids, Br, I, and Cl, are found at the positive pole.

In order to limit the extent of this paper, I shall confine myself to the above combinations or types. Br, I, and Cl are powerful gases, especially active in the nascent state in which they are brought in contact with the tissues in electro-medication. I shall not here treat of the possibilities of conducting the electrolyte *into* and *through* the tissues, but merely of its effects *upon* the tissues in contact with the pole at which it is set free.

If we place positive and negative poles of a galvanic battery, armed each with a platinum needle, into a glass filled with a solution of iodide of potash and starch, we will at once see the bubbles of hydrogen rising at the negative needle, and the fluid about the positive pole turning blue from the action of the

developing iodine on the starch; in like manner is the iodine set free at the positive pole when in contact with the tissues.

Saturated solutions must be used and prepared at the time, as solutions which have been standing are no longer serviceable on account of chemical changes which take place.

Platinum should be used as a carrier, as most of the nascent metalloid is taken up by other metals and lost to the tissues, if the electrode be of susceptible metal.

The stronger the current the more rapid the development.

The positive pole must be the active pole, and must carry the solution in contact with the tissues to be acted upon.

The negative must be the dispersing pole.

These applications are admissible only in cases in which galvanism is not contraindicated.

They can be made most effective in locations in which greater quantities of the fluid can be applied, as in the vagina, in the uterus, and on the abdomen, where large electrodes can be placed.

These applications may be made directly for the purpose of medicating the diseased surface, or as an addition to the proper application of the electric current, as indicated in the case—*e. g.*, in making a vagino-abdominal application of galvanism for purposes of absorption in chronic perimetritis, we obtain precisely the same effect from the electric current, whether we use the abdominal plate saturated with water or with iodide of potash; but in the latter case we assist its action by the developing iodine.

Iodine may be applied in cases of cellulitis by the usual vagino-abdominal application.

a. With the positive dispersing electrode, satu-

rated with iodide of potash over the diseased side, and the negative cotton-covered ball electrode in the vagina, using currents of 40–80 milliampères.

b. With the vaginal ball electrode covered with absorbent cotton saturated with iodide of potash in the vagina, and the negative dispersing plate on the abdomen, using currents 40 to 80 milliampères, or over; in this case the vagina can be filled with the fluid, and a more effective action be produced.

c. In cases of hyperplasia and metritis a saturated solution of iodide of potash is applied to the cavity, and after the tissues are moistened with this, a delicate applicator, best of platinum, is armed (as for medicinal application) with absorbent cotton, saturated with the solution, placed in the cavity, and connected with the positive pole; the abdominal dispersing plate being the negative pole. The current should be of such strength as it would be if used merely for its proper effect; but if this is less than 30 or 40 milliampères, the application should be prolonged to six, eight, or ten minutes, in order to allow of sufficient development of iodine; 100 and 150 milliampères may be used

Bromine. A powerful cautery and antiseptic; is useful—

a. In endometritis with profuse secretion, or with offensive discharge, as an intrauterine application, bromide of potash being used in precisely the same manner as the iodide in the last-mentioned case.

b. To the cervix the application may be made by saturating the cotton covering of the positive electrode with the solution and pressing it against the tissues.

Chlorine is developed from common salt or from chlorate of potash, and will prove less serviceable

than either of the preceding agents. Chlorine may be used in the uterine cavity after the removal of offensive tissue by the curette or the douche.

These elements in their nascent state are indicated when a gentle, diffuse, and general action is desired, and the necessary accompaniment of this method of application, the galvanic current, will further the treatment; they are most effective if sufficient quantities of the fluid can be utilized.

Many other remedies may be so applied, and I have merely mentioned the above as examples of this method of electro-medication by which certain advantages may be attained, which will, I hope, be more fully developed by continued experiment. Possibly we may be enabled to carry remedies into the tissues, as was at one time hoped by that enthusiastic electrician and eminent surgeon, my honored teacher, Victor von Bruns, more than twenty years ago.

Recent operators have again claimed to have carried iodine into pelvic effusions by this means. I have myself only attained negative results in my attempts to develop this method of interstitial medication which would prove the turning-point of local applications, and a most progressive step, if it could be accomplished. As I have no results, I will not discuss the subject, and have confined myself to what I have found feasible, superficial electro-medication by gaseous elements in their most effective state, when nascent.

I have been gratified by the general interest which is taken in the development of gynecological electrotherapy, and more than pleased by the results of my efforts to establish the galvanometer, the use of effective currents, and the large dispersing plate for the indifferent pole; hence I have not waited to de-

velop fully this method of electro-medication, but now present to you the outlines and the fundamental principles of the method which I believe to be susceptible of development, and this I hope it will receive at the hands of one of our active workers who is interested in the success of electrotherapy.

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